like, and the wireless network module may include Infrared Data Association (IrDA), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), a wireless LAN, Zigbee, a Ubiquitous Sensor Network (USN), Bluetooth, Radio Frequency Identification (RFID), Long Term Evolution (LTE), Near Field Communication (NEC), Wireless Broadband Internet (Wibro), High Speed Downlink Packet Access (HSDPA), Wideband CDMA (WCDMA), Ultra WideBand (UWB), or the like.

[0073] The memory control unit **1160** may manage data transmitted between the processor **1100** and an external storage apparatus that may operate according to a different communication standard from the processor **1100**. The memory control unit **1160** may include a variety of memory controllers, or a controller that may control Integrated Device Electronics (IDE), Serial Advanced Technology Attachment (SATA), a Small Computer System Interface (SCSI), a Redundant Array of Independent Disks (RAID), a solid state disk (SSD), External SATA (eSATA), Personal Computer Memory Card International Association (PCMCIA) a USB, a secure digital (SD) card, a mini secure digital (mSD) card, a micro SD card, a secure digital high capacity (SDHC) card, a memory stick card, a smart media (SM) card, a multimedia card (MMC), an embedded MMC (eMMC), a compact flash (CF) card, or the like.

[0074] The media processing unit **1170** may process data processed in the processor **1100** or data input from an external input device, and may output a processing result to an external interface device so that the processing result may be transferred in video, sound, or in other ways. The media processing unit **1170** may include a GPU, a DSP, HD audio, a high definition multimedia interface (HDMI) controller, or the like.

[0075] As illustrated in FIG. **19**, a system **1200** in which the semiconductor device according to an embodiment of the present invention is applied may be a data processing apparatus. The system **1200** may perform input, processing, output, communication, storage, and the like to perform a series of operations on data, and include a processor **1210**, a main storage device **1220**, an auxiliary storage device **1230**, and an interface device **1240**. The system according to the embodiments may be a variety of electronic systems that may operate using a processor, such as a computer, a server, a personal digital assistant (PDA), a portable computer, a web tablet, a wireless phone, a mobile phone, a smart phone, a digital music player, a portable multimedia player (PMP), a camera, a global positioning system (GPS), a video camera, a voice recorder, Telematics, an audio visual (AV) system, or a smart television.

[0076] The processor **1210** is a core configuration of the system that may control interpretation of an input command and processing such as an operation and comparison of data stored in the system, and may include a MPU, a CPU, a single/multi core processor, a GPU, an AP, a DSP, or the like.

[0077] The main storage device **1220** is a storage location that may receive a program or data from the auxiliary storage device **1230** and execute the program or the data. The main storage device **1220** retains the stored content even when powered off, and may include a semiconductor device according to the above-described embodiments. The main storage device **1220** may use a tunneling transistor, in which a semiconductor material layer having a low band gap is inserted into or around a source, as a switching device.

[0078] The main storage device **1220** according to the embodiment may further include an SRAM or a DRAM of a volatile memory type in which all contents are erased in power off. Alternatively, the main storage device **1220** may not include a semiconductor device according to the embodiments but may include an SRAM or a DRAM of a volatile memory type in which all contents are erased when powered off.

[0079] The auxiliary storage device **1230** may store a program code or data. The auxiliary storage device **1230** may have a lower data processing rate than the main storage device **1220**, but may store large amounts of data and include a semiconductor device according to the above-described embodiments. The auxiliary storage unit **1230** may also use a tunneling transistor, in which a semiconductor material layer having a low band gap is inserted into or around a source, as a switching device.

[0080] The area of the auxiliary storage device **1230** according to the embodiments of the present invention may be reduced, so that a size of the system **1200** is reduced and portability of the system **1200** is increased. Further, the auxiliary storage device **1230** may further include a data storage system (not shown), such as a magnetic tape or a magnetic disc, a laser disc using light, a magneto-optical disc using magnetism and light, an SSD, a USB memory, a SD card, a mSD card, a micro SD card, a SDHC card, a memory stick card, a SM card, a MMC, an eMMC, or a CF card. Alternatively, the auxiliary storage device **1230** may not include a semiconductor device according to the above-described embodiments but may include a data storage system (not shown), such as a magnetic tape or a magnetic disc using a magnetism, a laser disc using light, a magneto-optical disc using magnetism and light, an SSD, a USB memory, a SD card, a mSD card, a micro SD card, a SDHC card, a memory stick card, a SM card, a MMC, an eMMC, or a CF card.

[0081] The interface device **1240** may exchange a command and data of an external apparatus with the system of the embodiment, and may be a keypad, a keyboard, a mouse, a speaker, a microphone, a display, a variety of Human Interface Devices (HIDs), or a communication device. The communication device may include multiple modules such as a module coupled to a wired network and a module coupled to a wireless network. The wired network module may include a LAN, a USB, Ethernet, PLC, or the like, and the wireless network module may include IrDA, CDMA, TDMA, FDMA, a wireless LAN, Zigbee, a USN, Bluetooth, RED, LTE, NFC, Wibro, HSDPA, WCDMA, UWB, or the like.

[0082] While various embodiments have been described above, it will be understood to those skilled in the art that the embodiments described are examples only. Accordingly, the circuit and method described herein should not be limited based on the described embodiments.

What is claimed is:

1. A method of manufacturing a semiconductor device, the method comprising:

sequentially forming an interfacial conductive layer and an etch stop layer on a resistive memory layer;

forming a main conductive layer on the etch stop layer;

exposing a portion of the etch stop layer by patterning the main conductive layer;

exposing a portion of the interfacial conductive layer by patterning the portion of the etch stop layer;